The Journal of Extension

Volume 53 | Number 5 Article 27

10-2015

Evaluation of Radon Outreach Programming in Chaffee and Park Counties, Colorado

Kurt M. Jones
Colorado State University Extension, Kurt.jones@colostate.edu

October 2015
Volume 53
Number 5
Article # 5RIB6
Research In Brief

Evaluation of Radon Outreach Programming in Chaffee and Park Counties, Colorado

Abstract

Colorado State University Extension in Chaffee and Park Counties conducted numerous outreach educational activities between 2007 and 2010. A follow-up evaluation was conducted to determine whether one outreach activity was more effective at encouraging individuals to test their homes for radon or to mitigate their homes. Participants in the face-to-face class reported an increase in knowledge about the hazards of radon gas exposure and the need to test homes/businesses on an individual basis. Based on these data, continued outreach education is warranted, a variety of outreach activities is necessary, and individual testing of homes and businesses is needed.

Kurt M. Jones
County Extension Director
Colorado State University Extension, Chaffee County
Salida, Colorado
kurt.jones@colostate.edu

Introduction

Housing is a well-established focus of Extension education (Maring, Singer, & Shenassa, 2011). As a component of housing education, Indoor Air Quality is an area of emphasis for many Extension educators engaged in housing education. According to the Environmental Protection Agency (EPA), Radon gas in the home is a primary cause of lung cancer in both smokers and non-smokers (2012). The EPA estimates there are 21,000 deaths each year caused by radon exposure. Radon is a unique environmental threat because it is odorless, and cannot be perceived, sensed, or experienced (Himes, Parrott, & Lovingood, 1996).

Over a 4-year period (2007-2010), Colorado State University (CSU) Extension conducted numerous radon education outreach programs, primarily in Chaffee and Park Counties, but also via distance delivery reaching people throughout Colorado. These programs included live face-to-face classes, information booths at local health fairs and county fairs, live (synchronous) distance education classes (via Adobe Connect Pro), and one-on-one consultation with residents. As a component of these delivery methods, residents received a short-term radon testing kit for use in their homes. While residents could receive specific radon levels for their homes directly from the laboratory, data was aggregated and reported back to the investigator by postal zip code and the radon level present for each unique kit number.

A follow-up evaluation was conducted in 2010 to determine whether one outreach activity was more effective at encouraging individuals to test their homes for radon or to mitigate their homes. The follow-up evaluation sought to determine prevalence of elevated radon levels as evidence for continued programming and whether one outreach educational program was more effective than others for knowledge gained, behavior change (change in short-term testing of homes), or condition changes (homes mitigated to reduce radon levels).

Methodology

The radon program participants who completed a short-term radon test on their home or business were selected as the target population. In August, 2010, permission was received from CSU Internal Review Board to conduct a follow-up survey of clients who had submitted their short-term radon testing kits for analysis to the laboratory. Mailing addresses were provided by the laboratory to CSU Extension. Of the 330 addresses provided, 230 surveys were mailed. Participants were selected via systematic random sampling of the non-alphabetized mailing list. Four of the addresses were left out because they were from out-of-state addresses. There were 22 surveys that were returned unusable (incorrect mailing address, new residents, and blank surveys returned). The response rate for the surveys was 103 of the original 230 surveys sent (45%).

During the same time period (2007-2010), CSU Extension received short-term radon testing results based on postal zip codes. Individual households were not able to be identified by these reports generated by the laboratory. The monthly reports were compiled and analyzed below.

Statistical analysis was conducted using IBM SPSS, 2012 edition. Statistics tests used included Wilcoxen Signed Ranks, Pearson correlations, Chronbach's alpha, and simultaneous multiple regression based on the prescribed evaluation. Specific tests are described in more detail below. Effect sizes, where applicable, were hand-calculated using the protocols outlined in Morgan, Leech, Gloeckner, and Barrett (2011). Research validity discussion (in the Discussion section) used the protocol outlined in Gliner, Morgan, and Leech (2009), with emphasis on external validity, internal validity, and measurement validity.

Knowledge-gained questions were designed as a "post-then-pre" selection where participants were asked *after* the class what their knowledge was pre-class and post-class. An example of the type of Likert-scale question is presented in Figure 1.

Figure 1.

Example of Likert-Scale Question

Please describe your level of knowledge about the hazards of indoor radon exposure **prior** to attending the class or information booth.				
1	2	3	4	5
No Knowledge	Minimal	Moderate	Advanced	Expert
Please describe your level of knowledge about the hazards of indoor radon				

exposure **after** attending the class or information booth.				
1	2	3	4	5
No Knowledge	Minimal	Moderate	Advanced	Expert

Results

Much of Colorado has the potential for elevated radon levels in the home (EPA, 2012), and the testing results show this to be true in Chaffee, Park and surrounding counties (Table 1). Using summarized data as a predictor for individual residents is not recommended because some properties have greatly elevated radon reading (e.g., Salida skewness = 7.81). Each home should be individually tested for radon levels, and those exhibiting levels above 4.0 pCi/L should be evaluated for mitigation (EPA, 2012).

Table 1.
Short-Term Testing Results for Radon in and Around Chaffee County

Location	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Median**[1]	**Skewness**	**Std. Error**
Salida	222	.3	198.7	10.27	16.83	6.25	7.81	.163
Buena Vista	59	.6	35.8	7.44	6.35	6.00	2.43	.311
Nathrop	22	1.5	39.6	15.77	11.63		.70	.491
Poncha Springs	14	1.3	26.0	9.81	7.99		.70	.597
Park County[2]	63	.5	63.0	9.01	12.31	5.60	2.76	.302
Neighboring[3]	11	1.2	55.6	9.02	15.71	3.80	3.12	.661
Misc. State[4]	34	.6	357.0	20.39	61.39	7.40	5.34	.403

[1]Median is reported for areas where skewness exceeds 1.0 as measure of central tendency.

[2]Park County includes all zip codes within Park County, Colorado. None of the areas exceeded 10 kits per zip code, so they were all combined to maintain confidentiality.

[3]Neighboring Counties to either Chaffee or Park County.

[4]Kits from Colorado Zip Codes not included in any other area.

In order to quantify whether Chaffee County residents have the potential for elevated radon levels in their homes, short-term radon testing results were compared against the EPA action level of 4.0 pCi/L. Due to the skewness of the results of the short-term tests, the parametric one-sample t-test was not used. Instead, the nonparametric Wilcoxen Signed Ranks test was used against the EPA action level. Each of the four locations in Chaffee County (Table 2) showed statistical significance for having elevated radon levels. Park County locations were not considered in this analysis due to the low return rate of testing kits for each postal zip code and the researcher's desire to protect anonymity.

Table 2.

Ranks[a] and Statistics for EPA Action Level (4.0 pCi/L) and Selected Chaffee County Locations

Variables	***N***	**Mean Rank**	***Z***	***p***
EPA Action Level < Salida (High Tests)	147	133.61	7.75[b]	< .001
EPA Action Level > Salida (Low Tests)	74	66.09		
EPA Action Level = Salida	1			
Total Salida	222			
EPA Action Level < Buena Vista (High Tests)	39	36.36	4.02[b]	< .001
EPA Action Level > Buena Vista (Low Tests)	20	17.60		
EPA Action Level = Buena Vista	0			
Total Buena Vista	59			
EPA Action Level < Poncha Springs (High Tests)	9	9.33	1.98[b]	.048
EPA Action Level > Poncha Springs (Low Tests)	5	4.20		
EPA Action Level = Poncha Springs	0			
Total Poncha Springs	14			
EPA Action Level < Nathrop (High Tests)	20	12.10	3.75[b]	< .001
EPA Action Level > Nathrop (Low Tests)	2	5.50		
EPA Action Level = Nathrop	0			
Total Nathrop	22			

[a] Wilcoxon Signed Ranks Test

[b] Based on High Tests

Results from the mailed surveys offered some evidence of knowledge gain and behavior change. Using a five-point Likert scale, respondents reported a pre-class knowledge of the hazards of radon at a mean of 2.24 and post-class knowledge at a mean of 3.49 (n=99). They also reported a pre-class knowledge of the importance of testing at a mean of 2.21 and a post-class knowledge at a mean of 3.69. Of note, respondents reported an indication of behavior change, as evidenced that 18% had tested for radon prior to the class and 95% reported testing after the class. Perhaps the most encouraging result was that 25% of the respondents had installed a radon mitigation system in their homes (n=100). Respondents reported that they attended a live class (51%), participated in the online class (8%), visited the educational booth (24%), and/or followed up with one-on-one consultation (28%). There were some that used more than one educational event.

Each of the four variables were normally distributed (Table 3), and the assumption of linearity was not markedly violated. Pearson correlations were computed to examine the intervariable correlations. Table 3 shows that the four pairs were significantly correlated, even with the Bonferroni correction taken into account (p = .05/8 = .00625). Two correlates (PreHazard/PreTest and PostHazard/PostTest) are of practical importance. To test instrument reliability, Chronbach's alpha was conducted for the four variables (.77) and for the Pre-Class variables (.82) and Post Class variables (.83). Each of these alphas are considered sufficient (above .70, Morgan et al., 2011).

Table 3.

Intercorrelations, Means, Standard Deviations, and Skewness for Evaluation Variables (N = 99)

Variable	Know PreHazard	Know PostHazard	Know PreTest	Know PostTest	Mean	SD	Skewness
KnowPreHazard	1	.44*	.70*	.32**	2.24	.81	.04
KnowPostHazard	----	1	.36*	.72*	3.49	.61	-.51
KnowPreTest	----	----	1	.29***	2.21	.86	.17
KnowPostTest	----	----	----	1	3.69	.68	-.31
Statistical Significance: *p < .001 **p = .002 ***p = .004							

The strongest correlations (Table 3) are between the Pre-Course Knowledge of Hazards and Testing $r(97) = .70$, $p < .001$ and the Post Course Knowledge of Hazards and Testing $r(97) = .72$, $p < .001$, with an effect size considered larger than typical for each correlation. This is an indication of the efficacy of the outreach programming, but also suggests the need for Extension educators to provide radon outreach programming based on the knowledge reported prior to participating in the class.

Discussion

The survey instrument was created to gather feedback from participants in one of four radon education outreach venues: live class, distance education class, education booths at local events, and one-on-one consultation. To determine research validity, the following are offered for external validity, internal validity, and measurement validity.

External validity refers to the characteristics of the participants in the evaluation and the environment in which they were surveyed. The radon program participants who completed a short-term radon test on their home or business were selected as the target population. Of those radon kits returned over the 4-year period, there were 330 unique addresses generated. Evaluation funding for the program permitted the surveying of 230 addresses. How participants were chosen was discussed in the methodology section. The population is considered medium-high due to the relatively low 45% response rate. It is not believed that this response rate introduced sampling bias, but a higher response rate was anticipated.

The setting where the evaluation takes place can affect the results. Having as close to a "natural" setting is preferable. Participants were able to complete the survey instrument in their homes, each of the participants had previously had contact with the evaluator, and the importance of the subject of the program, the ecological assessment is considered high.

One of the challenges of the survey instrument was the lack of demographic data collected. Due to the potential sensitivity of disclosure of elevated radon testing results, this information was not sought from respondents. Because of this, there was no ability to test subgroups such as age, gender, ethnicity, or location to further determine validity, rating for this is low. Overall external validity is rated as medium.

Follow-up evaluations of educational programs can often suffer from internal validity measurements. In the study reported here, there was no assignment of participants into experimental groups and no pretesting of a sub-cohort, and the study was not conducted in a controlled environment. In an attempt to improve these inherent characteristics, the survey instrument was evaluated by subject-matter experts during development, and the relatively large sample size helps to alleviate the extraneous variables. Internal validity would be considered low to medium.

Evidence of instrument validity and reliability was previously discussed in the results section in corresponding areas. Where appropriate, effect sizes were calculated and discussed. Measurement reliability would be considered medium to high. Based on these factors, overall evaluation validity is considered medium or typical for post-course evaluation designs.

Implications

One of the highlights of this evaluation and its results is outlined in Table 3. There was statistically significant evidence of knowledge gained as reported by the participants' knowledge of the hazards of radon gas prior to their participating in the class, and their knowledge of hazards following the class ($r = .44$, $p < .001$). This indicates that participants were generally unknowledgeable about the hazards of radon exposure before the class, but were knowledgeable following the class. This is also the case with testing for radon. There was statistical significance of the participants' knowledge of testing for radon gas prior to their participating in the class and their knowledge of testing following the class ($r = .29$, $p = .004$). This indicates that participants were generally unknowledgeable about testing for radon exposure before the class, but were knowledgeable following the class. Because these were overriding goals of the program, these results are practically significant and indicate that additional radon outreach programs are warranted in the future.

Also of interest is the radon testing results as reported by postal zip code (Tables 1 and 2). Table 2 indicates the statistical potential for a residence to experience elevated radon levels, though the range can vary tremendously (Table 1). Due to the varying nature of radon levels in the home, individual residences should be tested to determine their unique radon levels.

One of the research questions that the evaluation failed to show was the effect of the various outreach activities on the incidence of home mitigation. Simultaneous multiple regression was conducted to investigate whether multiple outreach activities could affect the incidence of home mitigation. It was thought that participants who participated in an outreach class who also followed up with one-on-one consultation would have increased their incidence of home mitigation system installation, but this was not the case. The combination of variables to predict home mitigation from outreach activities was not statistically significant, $F(4,81) = 1.66$, $p = .168$. The individual consultation was close to statistically significant ($\beta = .30$, $t = 1.92$, $p = .058$), perhaps suggesting that individuals were more likely to seek one-on-one consultation prior to investing their money into an active home mitigation system.

One of the demographic questions that should have been included on the survey instrument was for respondents to indicate the radon level of their home. Low radon readings would negate the need to mitigate the residence, but this data was unavailable. Another important extraneous variable affecting the incidence of radon mitigation system installation is the relatively high cost for professional installation. Some respondents may have chosen not to mitigate their homes due to the high cost, especially if their home radon test was only marginally elevated.

Conclusion

Radon outreach programming will continue to be an important topic for many residents. According to the EPA, it is the number 2 cause of lung cancer in the United States, second only to cigarette smoking. Extension is in a unique position to provide unbiased, research-based information and education on this important environmental hazard. The work is also quite rewarding, evidenced by knowledge gained (hazards of radon exposure and need for testing), behavior changes (routine radon testing), and ultimately reduced environmental hazards in the home (installation of active radon mitigation systems where warranted). Presented from a "Logic Model" viewpoint, for a relatively minimal investment of outputs, there are easily documented short-term (knowledge gain), medium-term (behavior change), and long-term (condition) changes in the program participants. In the words of a survey respondent, "You are wonderful, you safe lives!"

References

Environmental Protection Agency. (2012). *A citizen's guide to radon*. Retrieved from: http://www.epa.gov/radon/pubs/citguide.html#overview

Gliner, J. A., Morgan, G. A., & Leech, N. L. (2009). *Research methods in applied settings: An integreated approach to design and analysis, 2nd edition.* New York: Routledge Taylor and Francis Group

Himes, L., Parrott, K., & Lovingood, R. (1996). The radon project: A study in environmental hazard education. *Journal of Extension*, 34(3) Article 3RIB2. Available at:

http://www.joe.org/joe/1996june/rb2.php

Maring, E. F., Singer, B. J., & Shenassa, E. (2011). Healthy homes: A contemporary initiative for Extension education. *Journal of Extension* [On-line], 49(2) Article 2FEA9. Available at: http://www.joe.org/joe/2011april/a9.php

Morgan, G. A., Leech, N. L., Gloeckner, G. W., & Barrett, K. C. (2011). *IBM SPSS for Introductory Statistics: Use and Interpretation, 4th Edition.* New York: Routledge Taylor and Francis Group.
